

A Regrettable Substitute: The Story of GenX

Ashley Ahearn

DuPont introduced GenX almost 10 years ago as a chemical substitute for perfluorooctanoic acid (PFOA). Although GenX was intended to be less environmentally persistent than PFOA, it has turned out to be what is known as a “regrettable substitute,” whose effects may be as bad as or even worse than the chemical it replaced. In this podcast, guest Jane Hoppin discusses her work assessing exposures to GenX and related chemicals in people living in the Lower Cape Fear River Basin of North Carolina. <https://doi.org/10.1289/EHP5134>

NARRATOR: *EHP* presents “The Researcher’s Perspective.”

AHEARN: It’s “The Researcher’s Perspective.” I’m Ashley Ahearn.

Teflon made cooking so much easier. No more eggs sticking to the bottom of the frying pan, just smooth sailing on your stovetop, with the help of nonstick chemicals—perfluorooctanoic acid, to be more specific, a chemical also known as PFOA or C8.

It’s a suspected carcinogen¹ that has been largely phased out in recent years. But some public health experts are concerned that its replacement is no better.

DuPont introduced GenX (and no, we’re not talking about the generation born after the Baby Boomers) as a chemical substitute for PFOA.² Very little is known about the public health effects of GenX, but it’s showing up in the drinking water of communities downstream of a chemical plant that produces it near the Cape Fear River in North Carolina.

Joining me to talk about it is Dr. Jane Hoppin. She’s the principal investigator of the GenX Exposure Study³ and the deputy director of the Center for Human Health and the Environment at North Carolina State University. She’s also an associate editor of *Environmental Health Perspectives*.

Dr. Hoppin, welcome to “The Researcher’s Perspective.”

HOPPIN: Thank you. Happy to be here.

AHEARN: You and your colleagues were the first to report the presence of GenX in water samples from the Cape Fear watershed a few years ago. Will you tell me that story?

HOPPIN: So, I have to give all the credit to my colleague Dr. Detlef Knappe—who is a professor in civil and environmental engineering here at NC State—and his colleagues, Mark Strynar and Andy Lindstrom at EPA here in Research Triangle Park, because they’ve been investigating PFAS in the Cape Fear River watershed for a number of years, since 2013.

And so what came to light, though, was in December of 2016, Dr. Knappe and his colleagues published a paper⁴ that showed that GenX and related per- and polyfluoroalkyl substances, or PFAS—which is the category of chemicals that GenX belongs to—were found in the Lower Cape Fear River, which is the drinking water source for Wilmington, North Carolina, which is a city of about a quarter million people.

And not only did they find these chemicals in the river, they also found it in the finished drinking water, which meant that even though there was very good water treatment by the Cape Fear Public Utility Authority, these chemicals were passing through. So, people were drinking the same concentration that was in the river.

And so, the paper was published in December of 2016, and it took a little while for the media to get ahold of it. But when it did, it went like gangbusters. So, June 7th of 2017, Adam Wagner⁵ of the *StarNews* in Wilmington wrote an article⁶ about this. And within a week, there were public meetings in Wilmington to discuss what the problem was. And then by the end of June—so, three weeks later—the [North Carolina] state

Department of Environmental Quality required the chemical company upstream to stop releasing GenX to the Cape Fear River.

So, within three weeks, this community went from 700 parts per trillion of GenX into their drinking water to less than the state standard, which became 140 parts per trillion. But the big question to people in Wilmington was, how long has this been going on? Because it may have been released to the Cape Fear River since 1980. So that’s the background of when we got involved.

AHEARN: Okay, so before we dive into your research, I want to back up here just a bit. Tell me about GenX. What do we know about how it behaves in the environment, or in our bodies for that matter?

HOPPIN: Well, that is the question. GenX was designed by DuPont to be less environmentally persistent than PFOA, which means that it has an ether group where carbon was, which is supposed to make it less persistent in the environment and less persistent in our bodies. There’s very little toxicological data on this chemical, but we do know about PFOA and PFOS and some of the potential health consequences associated with exposure to those chemicals. And these include common things like increased cholesterol and thyroid outcomes, and rare outcomes like ulcerative colitis. There’s also concern about altered immune function and some types of cancer for PFOA and PFOS.

So, of this big family of PFAS, we know that PFOA and PFOS have been associated with human health outcomes. So, one of the things we want to figure out is, are these new chemicals also associated with those health outcomes?

AHEARN: Dr. Hoppin, tell me about the GenX Exposure Study you’ve been conducting in New Hanover County. How many people participated, and what kind of data are you collecting?

HOPPIN: So, the GenX Exposure Study was funded through the NIEHS Time-Sensitive Grants Program to respond to emerging environmental health threats. And so, we submitted a grant at the beginning of August [2017] to really answer three key questions: Is the chemical in me? What predicts this chemical in me? And what are the health effects of this chemical? So, we designed the study with our community partners to answer those three questions.

And so, we were funded November 1st, 2017, and then two weeks later we enrolled 310 Wilmington residents, where we collected blood and urine, and we collected a tap water sample from people’s homes. And we enrolled people 6 and older who had lived in the community for at least a year, because we wanted people who had been on the community water system for at least a year to have some level of exposure.

One of the reasons that we moved so quickly was that we didn’t know anything about the half-life of GenX. So, the half-life of PFOA is in the range of four to five years. The half-life of other C6-related chemicals is in the range of 32 days. So, five half-lives is estimated to be the time that you would have

complete removal of a chemical from the body. So, if [a chemical] has a 30-day half-life, five months later we wouldn't expect to see it. But we were trying really hard to capture that. And so we enrolled 310 people in November of 2017, and then in May of 2018 we enrolled about 34 new people and resampled people so that we could get some idea of a short-term half-life—are levels changing in six months?

AHEARN: And what have you found thus far?

HOPPIN: In the water sample, we identified three new PFAS for which we didn't have standards. So, we started with the water because we had experience doing that, and by identifying these new chemicals, we were able—when we analyzed the blood—to have chemical standards for this. And the lack of chemical standards indicates how rare these chemicals are.

So, we're finding new things, and we can't tell people how much we have without the chemical standard. So, we found not only did we measure GenX in the drinking water, we also measured Nafion by-product 2, another chemical called PFMOAA, and another in the PFO family. So, these were additions to PFOA and PFOS and some of the historically used PFAS chemicals.

Most importantly, we did not measure GenX in the blood of Wilmington residents. And so, whether this happens to be that people stopped drinking water with GenX when they found out about it and it's not there anymore, or it has a very short biological half-life and we missed it, we, we don't know the answer to that. But we do know that other people looking for GenX with good analytic methods also have not seen it. And the good news was that for all these new chemicals, the levels of the chemicals had dropped in six months, so that the levels are coming down.

So that was all important and interesting. But we also looked at the historically used chemicals. We wanted to be able to compare the people in Wilmington to the U.S. population in general. And so, what we found was that on average the median levels of PFOA in Wilmington were four times that the national average. In another way in looking at our data was that the median level for people in Wilmington exceeded the ninety-fifth percentile for the United States, so that the levels of PFOA exposure were much higher than the U.S. population. So that's something we didn't expect to see. And so we're also now trying to figure out that. We saw similar elevations with some of the other historically used compounds⁷.

AHEARN: Dr. Hoppin, how has the community received this information and your findings? Have you met with study participants and helped to explain your results to them? And, and if so, how did they respond?

HOPPIN: We have a very active community engagement process. We've partnered with Cape Fear River Watch, as well as the New Hanover County Health Department. So, when we share information, we first share information with study participants, and then we have a public meeting to share it more broadly.

Overall, I think that people are concerned. Why are these chemicals in their body? We're not in a position to do anything about it, but we're committed to sharing what we know when we know it, with the expectation from everybody that we don't always know what it means, but we'll come back. And so, we've already shared our water results and our blood results, and we're planning, once we finish the urine analysis, then we'll share those. And then as we move forward to more of the statistical analysis and sharing updates from that along the way.

So, it's a very iterative process and we really try to provide the best information that we have, host and attend public meetings, to talk to people in different forums. We enrolled people in Spanish as well as English. So, we've created documents in both English and Spanish. And so, we're really trying to reach out to the whole community to help answer some of the questions.

AHEARN: And what do you see now as the most pressing questions about GenX and this family of chemicals, as you move forward with this study?

HOPPIN: The most pressing question is it's not just GenX, it's all these different chemicals, and so how do we consider all these chemicals at the same time? Because we could just add them up, which would argue that chemical A has the same effect as chemical B. And understanding chemical mixtures is a really important scientific question—both epidemiologically and toxicologically—and so think about how we address this whole chemical mixture I think is really important.

The second big question is, how do we think about the past? Is that we know that GenX was basically turned off at the end of June of 2017, but exposure may have been occurring since somewhere in 1980. So, if we can't measure that in people's bodies it doesn't mean that it may not have had a health effect. So how do we think about the historic exposure? So that's another thing that we're trying to understand right now.

AHEARN: Dr. Hoppin, do you see cause for concern given your findings?

HOPPIN: I think that it's important to learn more about this, because these chemicals that we're measuring in people, most of them are by-products of chemical production—so, things that we know even less about than the chemicals that are used as active ingredients in chemical production. And we know nothing about the health effects of these specific chemicals. But PFAS chemicals, there's thousands of them, and they're used in a variety of materials and unfortunately have contaminated a lot of drinking water sources around the world. So, in other communities, people are looking at PFAS from firefighting foam that has contaminated drinking water wells.

So, I think there's a big public health concern to really know more about this entire class of chemicals, because we're measuring 10 different PFAS chemicals in everybody. So, we can't really think about them one at a time, but does their toxicity change?

So, it's unfortunate that the people in Wilmington are the first people that we've found these chemicals in, and some of them may be unique to the lower Cape Fear River. But chemicals like GenX are also used in manufacturing in the Netherlands, and so, there's also been concern there. So, I think that these chemicals are an important public health concern due to the extent to which they are found in both surface water and groundwater that's used for drinking water sources in the U.S. and around the world.

AHEARN: Dr. Hoppin, thank you so much for joining me.

HOPPIN: You're welcome.

AHEARN: Dr. Jane Hoppin is the principal investigator for the GenX Exposure Study and the deputy director of the Center for Human Health and the Environment at North Carolina State University. She's also an associate editor of *Environmental Health Perspectives*.

I'm Ashley Ahearn. Thanks for listening to "The Researcher's Perspective."

The views and opinions expressed in this podcast are solely those of our guest and do not necessarily reflect the views, opinions, or policies of Environmental Health Perspectives or the National Institute of Environmental Health Sciences.

References and Notes

1. Vaughn B, Winquist A, Steenland K. 2013. Perfluorooctanoic acid (PFOA) exposures and incident cancers among adults living near a chemical plant. *Environ Health Perspect* 121(11–12): 1313–1318, PMID: [24007715](https://pubmed.ncbi.nlm.nih.gov/24007715/), <https://doi.org/10.1289/ehp.1306615>.
2. E. I. du Pont de Nemours and Company. 2010. DuPont™ GenX Processing Aid for Making Fluoropolymer Resins: Setting a New Industry Standard for Sustainable

- Replacement Technology. Wilmington, DE: E. I. du Pont de Nemours and Company. <https://api1.ibabs.eu/publicdownload.aspx?site=slidrecht&id=100013871> [accessed 24 January 2019].
3. Center for Human Health and the Environment, North Carolina State University. 2019. The GenX Exposure Study [website]. <https://chhe.research.ncsu.edu/the-genx-exposure-study/> [accessed 24 January 2019].
 4. Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, et al. 2016. Legacy and emerging perfluoroalkyl substances are important drinking water contaminants in the Cape Fear River watershed of North Carolina. *Environ Sci Technol Lett* 3(12):415–419, <https://doi.org/10.1021/acs.estlett.6b00398>.
 5. Note: Adam Wagner has written dozens of articles for the *StarNews* on GenX in the Cape Fear River. However, the article published 7 June 2017 was actually written by Vaughn Hagerty.
 6. Hagerty V. 2017. Toxin taints CFPWA drinking water. *StarNews*, online edition, 7 June 2017. <https://www.starnewsonline.com/news/20170607/toxin-taints-cfpwa-drinking-water/1> [accessed 24 January 2019].
 7. Initial results were publicly released 13 November 2018: Hyland M. 2018. Researchers: blood samples don't detect GenX, but do find newly identified compounds. WNCN CBS 17, 13 November 2018. <https://www.cbs17.com/news/north-carolina-news/researchers-blood-samples-don-t-detect-genx-but-do-find-newly-identified-compounds/1595692001> [accessed 24 January 2019].